Introduction

This unit aims to:

- Explain why communication lies at the heart of people's use of computers.
- Show how communication relies on agreed representations which associate a symbol with a meaning.
- Study the properties of representations which are useful in a computing Context.
- Explain the importance of picking the right representation (one that is fit-for-purpose).
- Show how agreed formats for representing data stored in files promotes the sharing of this data.

Communication, Convention and Representation

- Communication is the act of imparting information.
  - Different forms of communication are: human-human, human-machine and machine-machine.
- Human need to communicate with computers to:
  - Communicate with each other.
    - Internet connectivity, Chatting, E-mail, Email behavior and conventions (Netiquette).
  - To solve problems.
    - Word processing, Speech synthesis, Iris scanning and others.

Communication, Convention and Representation

- Chatting & Chat Room
  - Chat is the process of electronically chatting to others using a chat room.
  - A chat room is a web application that allows users to exchange messages synchronously with others 'present' in the same chat room (i.e. online, without a delay).
  - Chat rooms are often dedicated to particular topics.
- Email (The software that uses the internet to enable users to send messages to each other)
  - Advantages
    - Email is immediate: it gives virtually instantaneous access to others;
    - It is global: people can be reached all over the world;
    - It is comparatively cheap;
    - It allows a variety of messages (including sound and image) to be sent.
  - Drawbacks
    - Less time for reflection, because email access is immediate;
    - The risk of sending mail to the wrong persons is high, because it gives access to a large number of recipients;
    - Email appears to invite short informal communication which is not always suitable for all messages;
    - Short, hastily-written mail messages carry relatively little information on mood, so they are easily misunderstood.
      - Emoticon/Smiley: A small caricature of simple facial expression composed of simple keystrokes inserted into text to convey an impression of the state of mind of the author.

Communication, Convention and Representation

- Appropriate use of any means of communication requires people to adhere to a set of conventions or guidelines.
  - **Netiquette** is the name for the collection of guidelines setting out appropriate email behavior.
  - Its guidelines lay down rules for sending and forwarding items under different circumstances, for participating in groups, and for posting messages on lists.
  - It aims to minimize discourtesy or misunderstanding in email use.
  - Refer to computer-based activities 2.1 to 2.4 to increase your awareness of netiquette.

Communication, Convention and Representation

- Using computers to solve problems requires four-way communication:
  1. Programmers need to instruct computers how to solve the problem given a variety of inputs.
  2. Users need to give computers the inputs to a particular problem.
  3. Computers need to communicate the solution (or lack of one) back to users.
  4. For tasks or problems which require more than one computer, the computers need to communicate with each other to share the problem.

Communication, Convention and Representation

- **A word processor** (like Microsoft Word or Word Perfect) takes a series of keystrokes (the input) and transforms it into an image on the screen (the output) or a neatly printed document (another output).
- **Speech synthesis** transforms a written text in computer-readable form (the input) into a stream of sound which is close to the human voice (the output).
- **Iris scanning** applications transform a scanned image of the iris (the input) into mechanical behavior such as the operation of a turnstile, or the opening of an ATM slot (the output).

Communication, Convention and Representation

- When the transformation process is so complex, it requires the cooperation of many communicating processors and computers. This requires more sophisticated computer systems such as supercomputers and superclusters.
- **Supercomputers** are very large, very fast computers. Unlike your PC, they have more than one processor, and a huge amount of memory. They are designed specifically to work on very large problems.
- **Supercluster** computers are collections of computers, each very much like your own PC. They are linked by very fast connections that allow the computers to share huge amounts of data and work on a problem in parallel. Very large problems are divided into smaller parts. All the computers in the cluster are set to work on different parts at the same time.

Communication, Convention and Representation

- Communication, whether with humans or with computers, relies on shared **conventions** used **deliberately** (i.e. with intention) and **explicitly** by communicating parties (i.e. with precise and exact ways of expressing messages).
- Languages are good examples of conventions used for communication since only people who understand a language will be able to use it to communicate.
- Language is also an interesting example because it involves conventions at many different levels.
  - There are conventions about the scripts which enable people to read and write.
  - Some languages are written left to right, right to left or from the top down.

Communication, Convention and Representation

- Conventions can be agreed in different ways (either Public, Local or Private) and can be shared by many or very few participants.
  - **Public** conventions have a very large number of participants.
    - The alphabetical classification system which relies on a publicly understood convention about the ordering of letters;
    - Reading a train timetable;
    - Finding a house with a certain number in a street.
  - **Local** conventions have a smaller group of participants (Local conventions are not private but they are useful only in specialist settings).
    - Radio codes used by police, ambulances and other public services;
    - Traders on a stock-market floor rely on hand signals to communicate with each other.
  - **Private** conventions are agreed between a handful of participants with a view to keeping communication private.
    - Secret codes, ciphers, and markers on hiding places, which are known to only a small number of people.

Communication, Convention and Representation

- **Protocols** are examples of conventions which govern communication between computers (and other machines), these may be public or local.
- A **handshake protocol** is a collection of conventions that enable computers (and other types of machines, like faxes) to identify each other.
- Breach of convention leads to a breakdown in communication.
- Examples of communication protocols between computers are:
  - HTTP (Hyper Text Transfer Protocol) for web pages addresses.
  - TCP/IP (Transmission Control Protocol/Internet Protocol) is possibly the most important internet protocol.
  - FTP (File Transfer Protocol) for downloading files from the Internet.
  - SMTP (Simple Mail Transfer Protocol) for sending and receiving emails.

Communication, Convention and Representation

- **Representations** play a central role in facilitating communication by establishing a relationship between some perceptible form (or symbol) and an associated meaning (or content) subject to some convention.
  - Crosses on churches, or crescents on mosques indicate places of worship for specific creeds, and are intended to be seen.
  - Bleeps at pedestrian crossings indicate the light is green, and are intended to be heard.
- To be effective in communication, a representation must meet at least the following conditions:
  - The form of the representation must be perceivable in some way;
  - The relationship between form and content is shared by all parties involved in the communication process.

Properties of Representations

- Humans have many different ways of perceiving representations, which are also used in our communication with computers.
  1. **Auditory** representations are perceived as sound.
     - Human use music and spoken language.
     - Computers use alarms and beeps to attract human attention, and sending sounds down a telephone line to 'shake hands' with other computers.
  2. **Visual** representations are perceived as sight.
     - Humans use written music and language, traffic signs, flags, and paintings.
     - Computers use scanners to 'see' images and the screen to communicate visual images.
  3. **Tactile** representations are perceived by touch.
     - Humans with visual and hearing impairments use various languages that rely on touch as the case with Braille language.
     - Computers use keyboards, joysticks, vibrating i-mice, and so on.

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Properties of Representations

- Representations have different properties that may play a role in deciding when they are best deployed.
  1. Representations are context (environment) sensitive because the form of representations can be associated with different meanings depending on the context. For examples:
     - A notice board of 'No hard hats, no work!' message at the entrance to a building site indicates the company's intention to enforce safety rules, however if it is carried in a demonstration, it conveys the workers' intention not to work unless they are provided with safety hats.
     - In Word the effect of pressing the arrow keys when editing a document is to move the cursor one position to the left, right, up or down in the text, however the effect of these keys in Microsoft Excel is to move the cursor to a different cell in the spreadsheet, and not in the text.

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Properties of Representations

- The following examples also show how representations can be context sensitive.

	'No smoking'	'Do not dispose of burning cigarettes in this bin' on the side of a bin in a smokers' area.
	'Stop' sign on Italian roads.	'Meeting point for altos' at a conference for singers!

Properties of Representations

2. Representations are ambiguous when the form of the representation can be associated with more than one meaning, even in the same context.
   - Ambiguity is the property of being ambiguous, where a word, term, notation, sign, symbol, phrase, sentence, or any other form used for communication, is called ambiguous if it can be interpreted in more than one way.
     - For a word, ambiguity typically refers to an unclear choice between different definitions as may be found in a dictionary.
     - A sentence may be ambiguous due to different ways of parsing the same sequence of words.
   - Whereas it is widespread in human language, ambiguity is not a common feature in the representations designed for communication with, or between, computers. Because computers cannot guess what a user might mean, representations have to be explicit and precise.

Properties of Representations

3. A representation will have a precision reflecting the granularity of the information it can capture. More precise representations contain more detail.
   - Example1: Digital clocks in railway stations typically show hours, minutes and seconds, however alarm clocks tend to show only hours and minutes. Both have a different precision.
     - The one showing seconds has a higher precision.
   - Example2: The different ways of representing money, or cost. Supermarket tills will list cost to the level of pence (e.g. £3.99 for a box of chocolates), however exchange rates typically are rendered to hundredths of a penny (e.g. $1=£0.6459).
   - Replacing a more precise representation with a less precise one results in information loss.

Properties of Representations

4. A representation may contain redundancy which reflects the extent to which its meaning can be recovered from part of its form.
   - Telephone numbers contain no redundancy: once a digit is lost, it becomes almost impossible to recover the number.
   - Library records, on the other hand, contain substantial redundancy because the complete record of a book can be recovered from the name of the author, the title of the book or the keywords therein, the book number, and the catalogue index.
   - Although redundancy has some benefits, it is not always in computing.
   - Detection and removal of redundancy is important in computing, because representations without redundancy are shorter, take up less space, and take less time to transmit.

Properties of Representations

- **Compression** is a technique which increases efficiency by removing redundancy from representations, and hence representations without redundancy cannot be compressed.
  - **Lossless** compression techniques do not lose any significant aspect of the original representation.
  - **Lossy** compression, on the other hand, loses parts of the original in a controlled way.
- **Decompression** is the reverse operation, where the redundant parts are put back into the representation to restore it to its initial form.

Picking Representation

- Complex representation systems are powerful tools, which allow form and meaning to be built up from more basic building blocks (i.e. simpler representations) in a systematic way.
  1. The form of the complex representation is made up of several more basic parts; and
  2. The meaning of the complex representation is constructed from the meanings of the more basic parts in some systematic way.

Picking Representation

- Traffic signs are complex representations.
  - The basic components to a traffic sign are:
    - its shape: triangular signs are warnings; round signs give orders;
    - its colour: red signs spell danger or prohibit specific behaviors; blue signs give positive instructions;
    - its symbol: most symbols are simple, recognizable icons (e.g. a picture of a bridge) or numbers.
  - Each of the building blocks contributes to the meaning conveyed by each traffic sign.

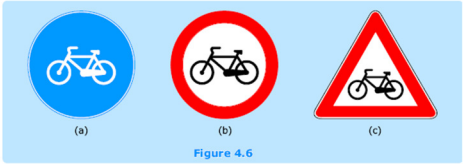

Figure 4.6

    - Figure 4.6(a) indicates a route only to be used by bicycles. It gives an order (it is round), with a positive instruction (it is blue), involving cycling (it shows a bicycle).
    - Figure 4.6(b) forbids cycling. It gives a prohibiting order (it is red and round), involving cycling.
    - Figure 4.6(c) warns that there may be cyclists around. It gives a warning (it is a triangle), spelling danger (it is red), involving cyclists.

Picking Representation

- Consequences of using a complex representation may be summarized as follows.
  1. New representations can be created within the system using the same rules.
  2. New representations can be interpreted by everyone who understands the rules, even when seeing them for the first time.
  3. When the rules of the system are breached, representations become incomprehensible. For example, a square red traffic sign with a white circle in the middle would not convey anything.
- Advantages of complex representation include the ability to devise new representations from the same building blocks, which everyone who knows the system will understand.

Sharing and Formats

- When you create a document containing some information, and you save it, you are in effect creating a file.
  - A file is a collection of information that is to be kept together in a specific representation, or format.
- You will need to give the document a unique name, called a filename, so that you can find it again. Windows systems list filenames in two parts separated by a dot:
  1. The file name you provide when saving the file.
  2. The file extension, that is the part of a *filename* that follows the full stop and tells the operating system the *format* for the file by which the system would know which application to launch in order to open it.

Sharing and Formats

- Popular file extensions

Extension	Use	Possible PC applications
.doc	PC document file: includes text and formatting information particular to Microsoft Word	Microsoft Word, some web browsers
.exe	Executable file: contains a program that will 'run' if you double click on it	N/A
.gif	Graphics Interchange Format file: stores pictures using a lossless compression and is widely used for the web	Web browser, Microsoft Photo Editor ",
.htm or .html	HTML file: contains text plus style formatting, and links to other files. Used for web pages	Web browser
.jpg or .jpeg	Joint Picture Experts Group file: stores graphics using a lossy compression technique. Used for photographs	Web browser, Microsoft Photo Editor
.mdb	Microsoft DataBase file	Microsoft Access
.mpg or .mpeg	Motion Picture Experts Group file: the format is used to display video pictures	Web browser, Media Player

Sharing and Formats

- Popular file extensions

Extension	Use	Possible PC applications
.mp3	Moving Picture Expert Group Audio Layer 3: a lossy compression format used for storing high-quality audio	Windows Media Player, iTunes
.mov	Another format used to display video pictures	QuickTime
.pdf	Portable document format file created by Adobe. The format can be read by most web browsers and is used extensively	Web browser, Adobe Acrobat Reader
.png	Portable network graphics: another popular format for storing pictures using lossless compression	Web browser, MS Photo Editor
.rtf	Rich text format file: can contain text, graphics and images plus styling information. Can be read by a wide variety of word-processors	Web browser, Microsoft Word
.txt	Plain text file without style information	Notepad, Microsoft Word
.wav	Sound format for Windows	Media Player, some web browsers

Unit Summary

- This unit explored the world of representations and showed that picking the right representation for a computer application can make a major difference to the success of the application.
- It gave a definition and examples of complex representation systems and illustrated the consequences of using such systems.
- It described the use of a particular file format given its extension and suggest a possible application that might be launched when the file is opened.